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FOR THE COMMANDER

HENNING E. VON GIERKE

Director

Biodynamics and Bionics Division Aerospace Medical Research Laboratory

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20. ABSTRACT (Continue on reverse side if necessary and identity by block number)

The USN A-7E is a carrier based, light attack aircraft powered by one TF41-A-2 turbofan engine. This report provides far-field measured and extrapolated data defining both physical and psychoacoustic measures of the bioacoustic environments produced by this aircraft operating on a ground runup pad for four engine/power conditions. Far-field data measured at 17 locations are normalized to standard meteorological conditions and extrapolated from 75-

7m

8000 meters to derive sets of equal-value contours as a function of angle and distance from the source. These contours are measures of: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise level, and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1 of this handbook, /USAF Bioenvironmental Noise Data Handbook, Vol 1: Organization, Content and Application, AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. The Company of the Co

PREFACE

Table of Contouts

This report was prepared by the Biodynamic Environment Branch, Aerospace Medical Research Laboratory, under Project/Task 723104, Measurement and Prediction of Noise Environments of Air Force Operations.

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INTRODUCTION

The USN A-7E is a carrier based, light attack aircraft powered by one TF41-A-2 turbofan engine. The aircraft was manufactured by the Vought Aeronautics Division of Ling, Tempco and Vought and the engines by the Allison Division of the General Motors Corporation.

This volume provides measured and extrapolated data defining bioacoustic environments produced by this aircraft during ground runup operations. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with ground runups of the A-7E aircraft.

This volume is one of a series published by the AMRL under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of military aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during ground operations of aircraft, ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. Volume 2 provides a method and data for adjusting the handbook's far-field noise data, which are for standard meteorological conditions (15 C temperature, 70% relative humidity, 0.760 meter Hg barometric pressure), to derive comparable data for other meteorological conditions. Refer to Volumes 1 and 2 (references 1 and 2) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., inflight/flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published and is available upon request from AMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of each updated index.

Direct any questions concerning the technical data in this report and other handbook volumes to: AMRL/BBE, Wright-Patterson AFB, OH 45433, AUTOVON 78-53675 or 78-53664; Commercial (513) 255-3675 or (513) 255-3664.

Cole, John N., USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application, AMRL-TR-75-50 (1) Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

Cole, John N., USAF Bioenvironmental Noise Data Handbook, Volume 2: Procedure to Evaluate Effects of Non-standard Meteorological Conditions on Far-Field Noise, AMRL-TR-75-50 (2), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

FAR-FIELD NOISE

MEASUREMENTS

AMRL acquired the far-field data during a 1-hour test period, thus keeping similar meteorological conditions throughout the test. Figure 1 shows the ground runup area (taxiway), ground cover, aircraft orientation and microphone measurement sites on the semicircle. The center of the 75 meter radius semicircle used in surveying the TF41-A-2 engine was on the ground directly below the intersection of the aircraft's centerline and the plane passing through the engine's exhaust-nozzle exit. The ground runup area did not have a blast deflector; therefore, the engine's exhaust was in a "free-flow" condition.

Table 1 provides cockpit readouts of engine characteristics (% RPM, fuel flow, etc.) for each power setting used in the far-field tests. Also listed in this table are the surface meteorological conditions during data acquisition.

All microphone measurement sites are in the acoustic far-field of the source where the sound wavefronts spherically diverge and the noise source may be regarded as a point source.

A portable microphone/tape-recorder system was used to sequentially record the noise at each far-field location. The microphone was attached to a hand-held pole, pointed at the source (0° angle of incidence) and vertically scanned from 0.5 to 3 meters for a period of 5-10 seconds during data acquisition at each microphone location. These samples were then time-integrated to derive a root-mean-square sound pressure level. Vertical sacanning and time-integrating together reduce anomalies frequently present in data acquired by a fixed height microphone.

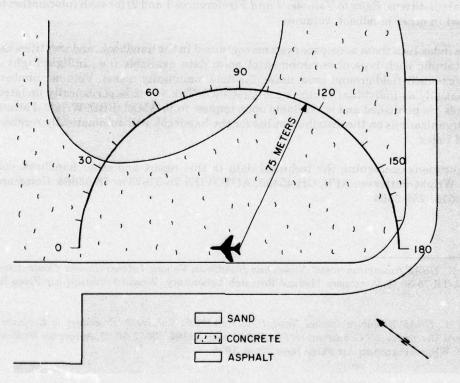


Figure 1. Far-Field Measurement Locations on The Taxiway at ALF, San Clemente Island

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TEST CONDITIONS FOR FAR/FIELD NOISE MEASUREMENTS

A-7E Aircraft, Ground Runups, ALF, San Clemente Island 15 May 1973

Aircraft Engine Operation

EPR Did Not Register 55 % RPM, Core Speed 432 C, Turbine Outlet Temp 1200 LBS/HR, Fuel Flow

70% Runup

EPP Did Not Register 70 % RPM, NC 422 C, TOT 1550 LBS/HR, FF

85% Runup

EPR Did Not Register 85 % RPM, NC 400 C, TOT 3700 LBS/HR, FF

Intermediate (Military)

3.88 Engine Pressure Ratio 94 % RPM, NC. 590 C, TOT 9000 LBS/HR, FF

Meteorology

Temperature Bar Pressure Rel Humidity Wind - Speed — Direction

17.8 C 0.767 M Hg 60 % 3.1 M/Sec (6 KTS) 350 Deg

RESULTS

Table 2 lists the overall and 1/3 octave band SPL measured at the far-field locations under meteorological conditions at the time of the test. Data in all other figures and tables are based on these levels. These data were normalized to 100 meters distance and standard meteorological conditions (15 C temperature, 70% relative humidity, 0.760 meter Hg barometric pressure) and used to derive the graphic data in Figure 2, which provides a compact summary of far-field noise characteristics of the A-7E aircraft in a standard format.

Figure 3 and Table 3 present two basic acoustic measures, the acoustic power level and the directivity index, respectively. The acoustic power level describes the power radiated by the source as afunction of frequency. The directivity index is a standard acoustical engineering measure that describes the geometric way in which the source radiates this powr as a function of both frequency and angle from source. These basic source measures are primarily of interest for acoustical engineers and noise generation/control specialists.

Estimates of the noise levels for intermediate power settings (e.g., 90% RPM) can be determined as explained in Volume 1 of this handbook.

Figures 4 through 10 are sets of equal noise contours describing seven different measures of noise as a function of angle and distance from the source for standard day meteorology. They are, respectively, overall sound pressure level, C-weighted sound level, A-weighted sound level, perceived noise level, speech interference level, permissible exposure times for personnel and octave band sound pressure levels.

Data excessively influenced by spurious background/electronic noise were eliminated from all figures and tables. No data are presented at the 170/180 degree locations for the idle and 70% RPM, nor at the 160/170/180 locations for the 85% RPM and the military power settings because of turbulent air flow behind the aircraft. Typically, the A-weighted levels for these angles are 10 to 20 dBA below the level measured at the preceding microphone location.

Test personnel performed noise surveys during quiet periods when the background noise was minimal, e.g., early in the morning when no other aircraft or engine test stands were operating. Data eliminated because they were near the background/electronic noise were generally not significant because the levels were so low (e.g., Table 2, idle power).

Volume 2 of the handbook describes the influence of meteorology on far-field noise environments, and provides, if required, the factors necessary to adjust the handbook's standard meteorological day data.

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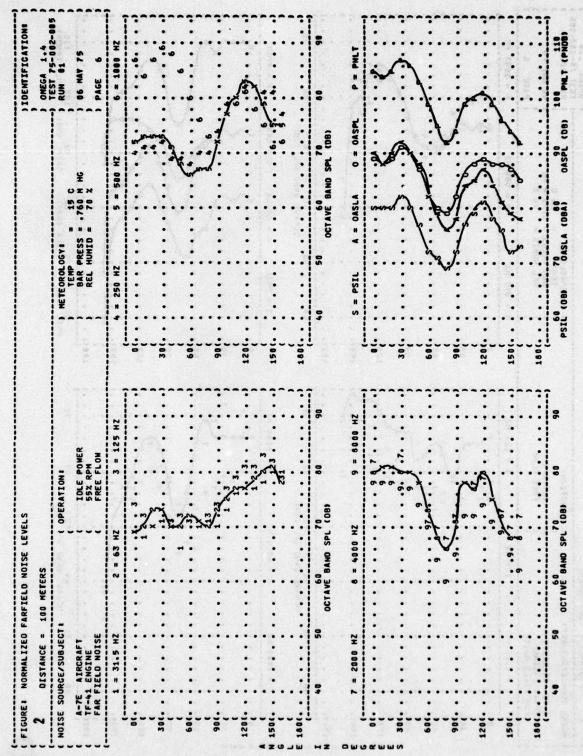
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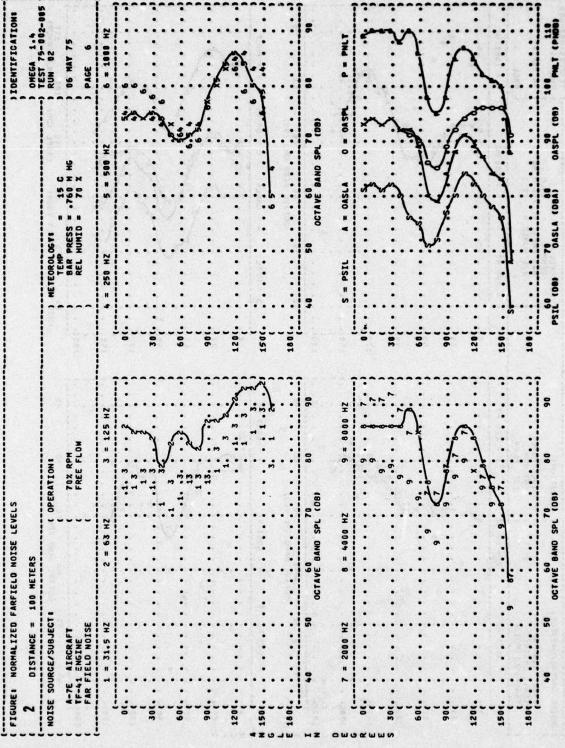
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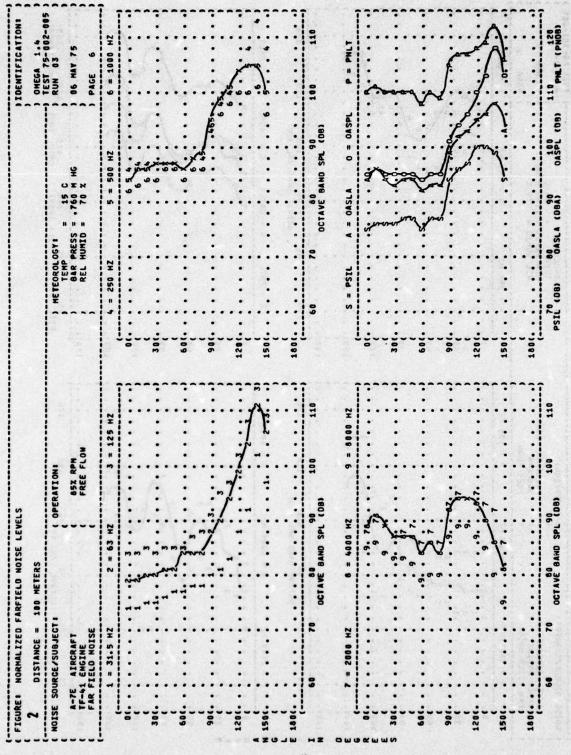
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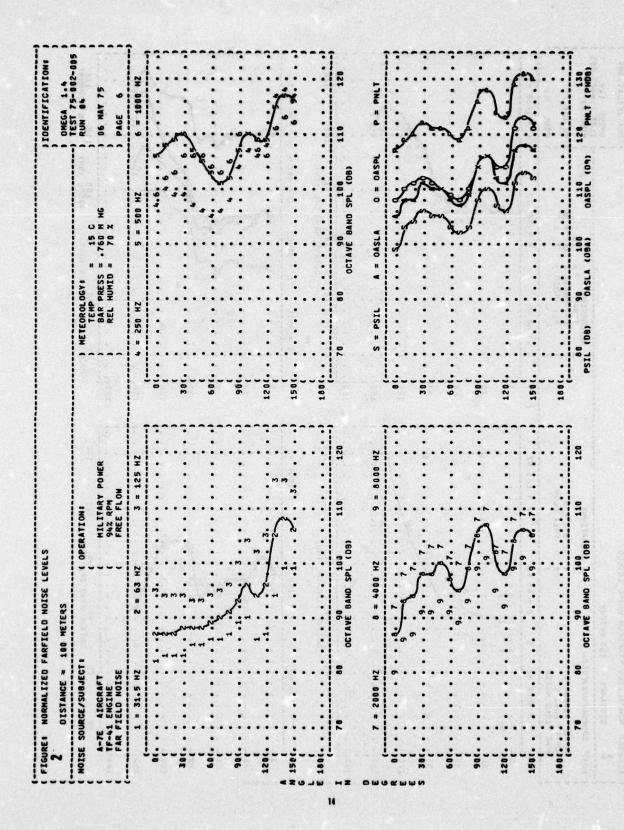
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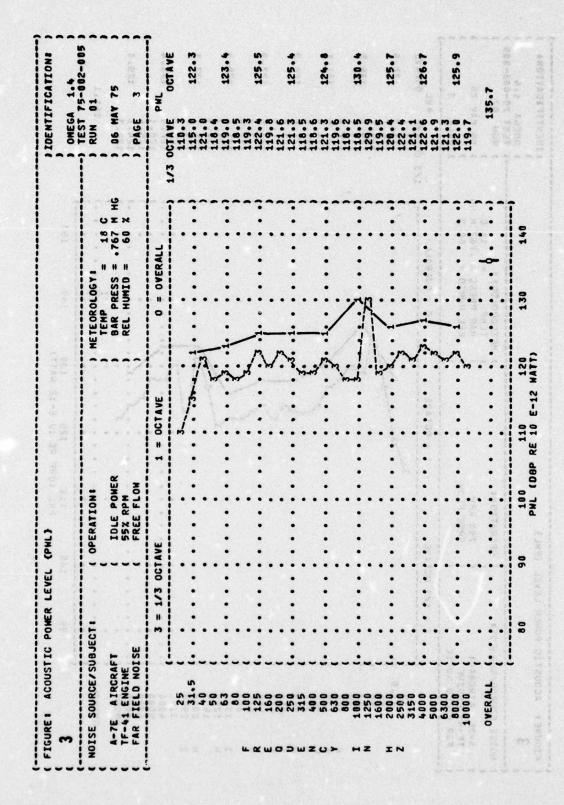
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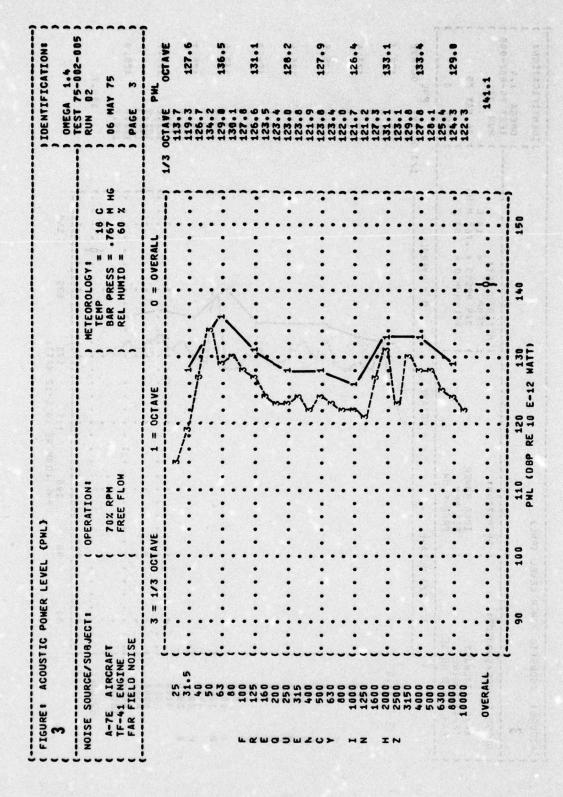


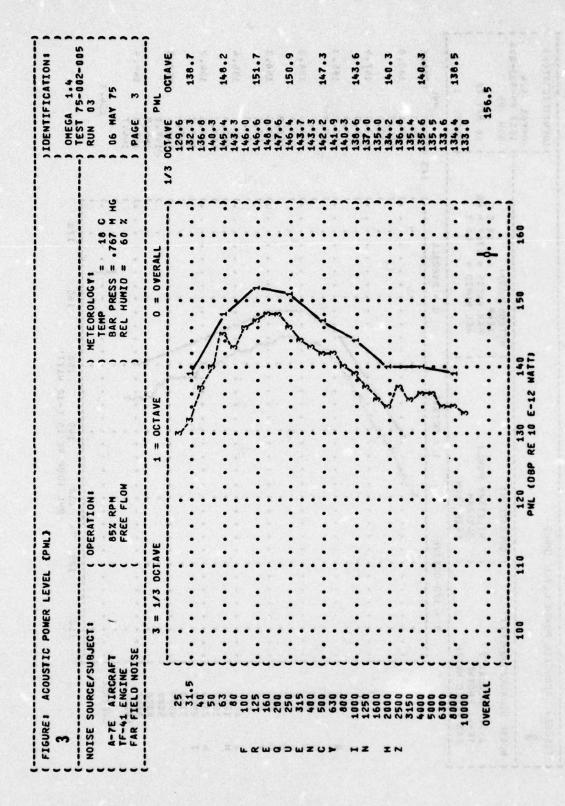


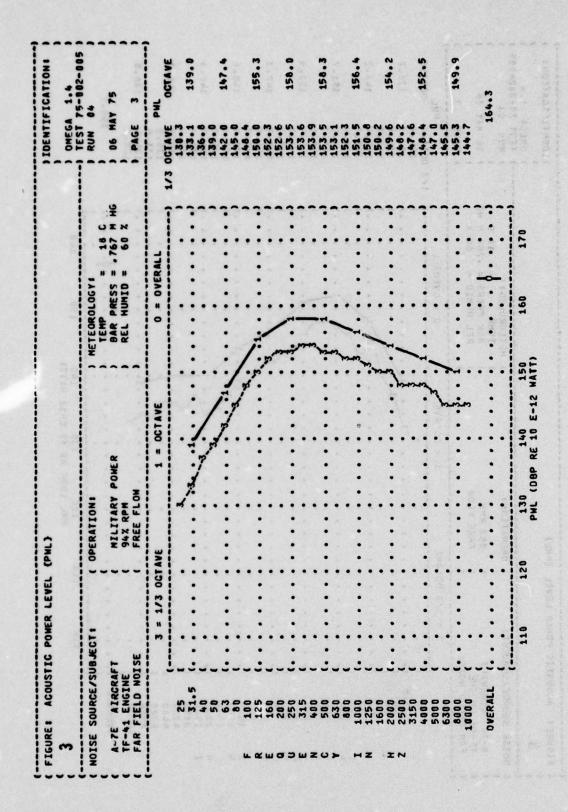




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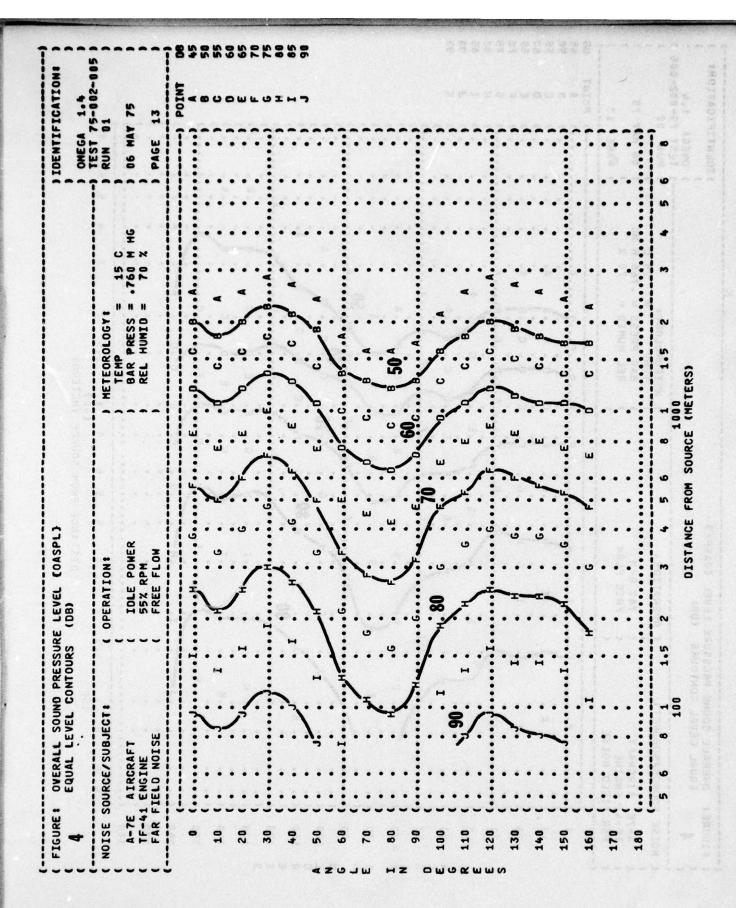
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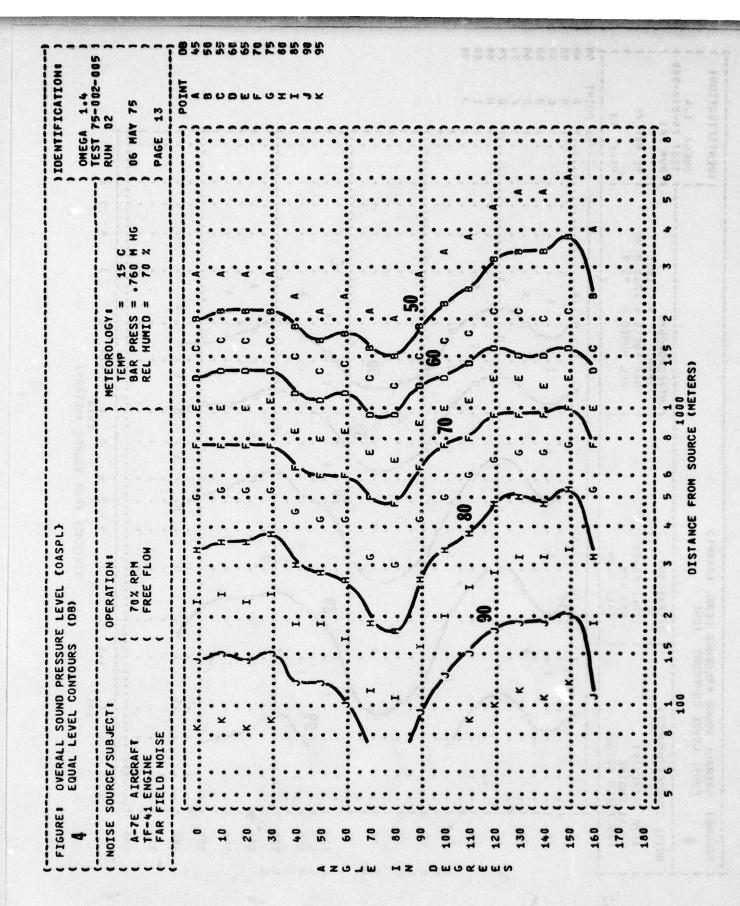
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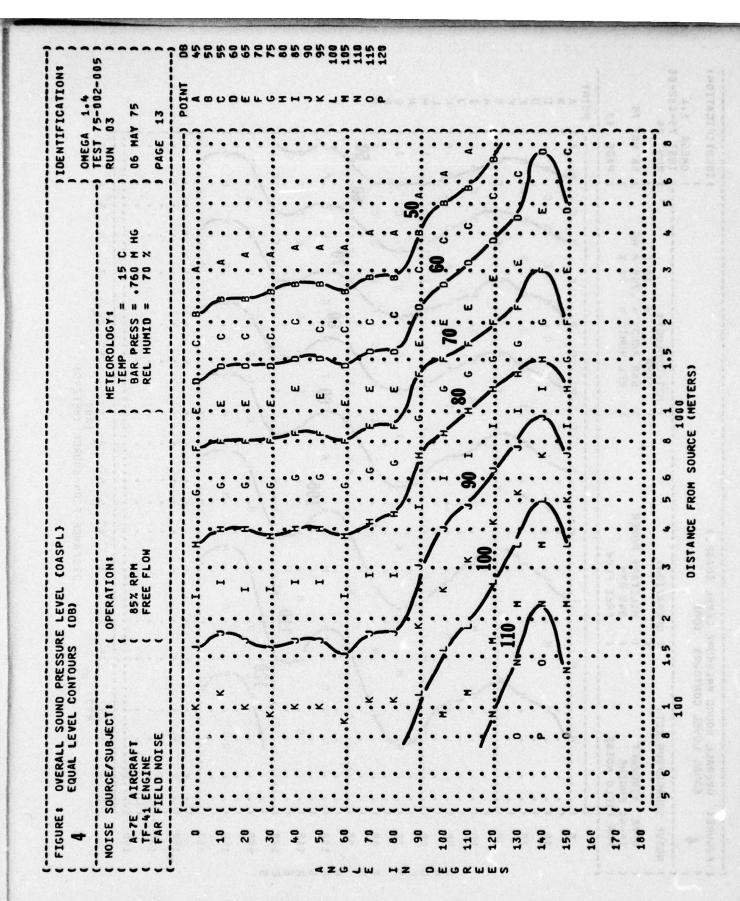
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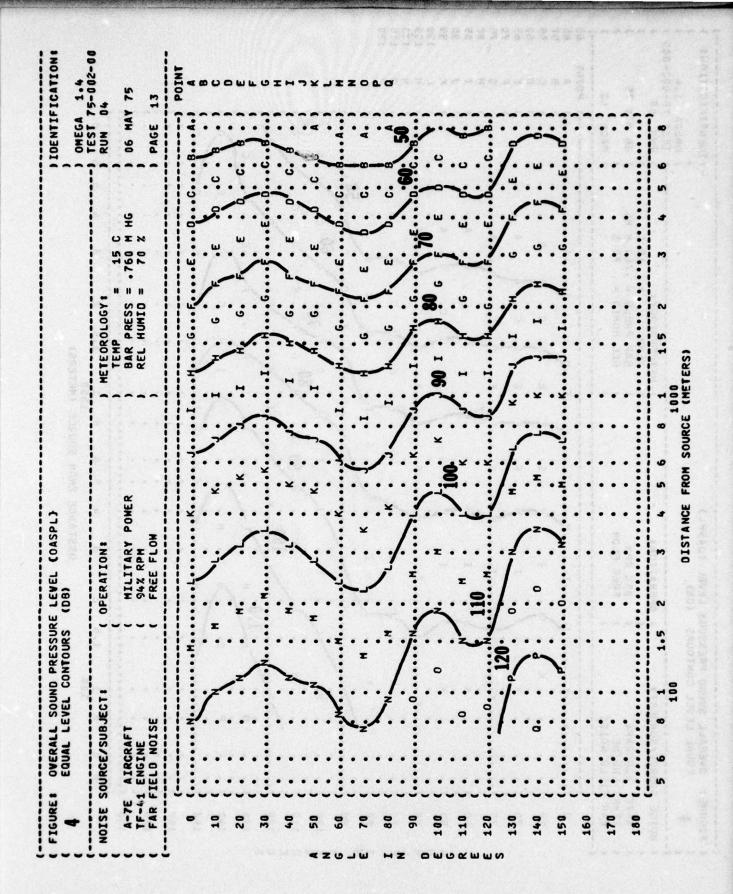
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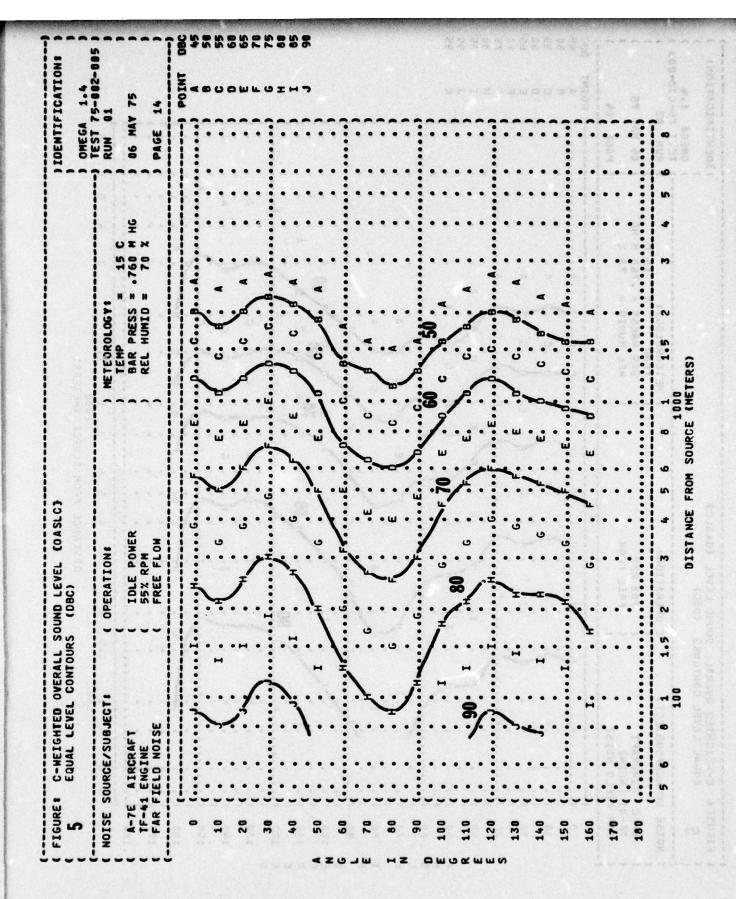


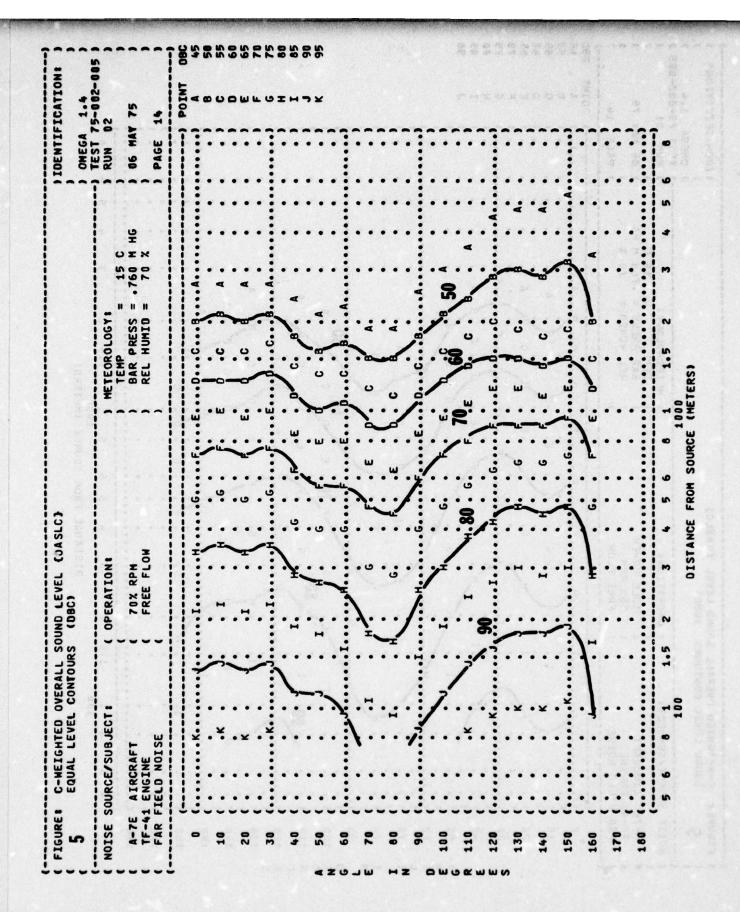


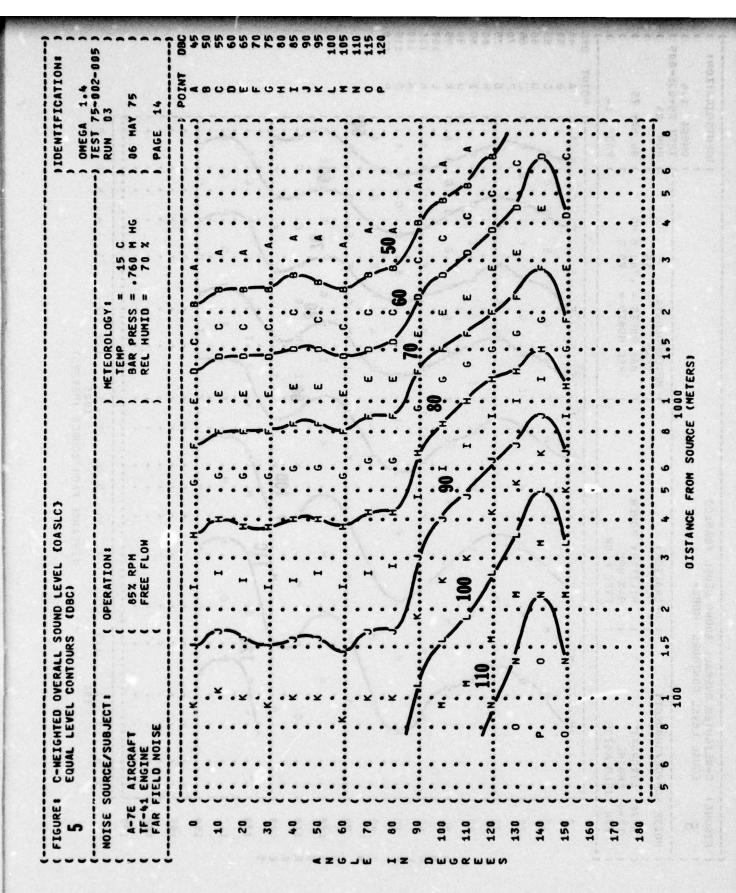


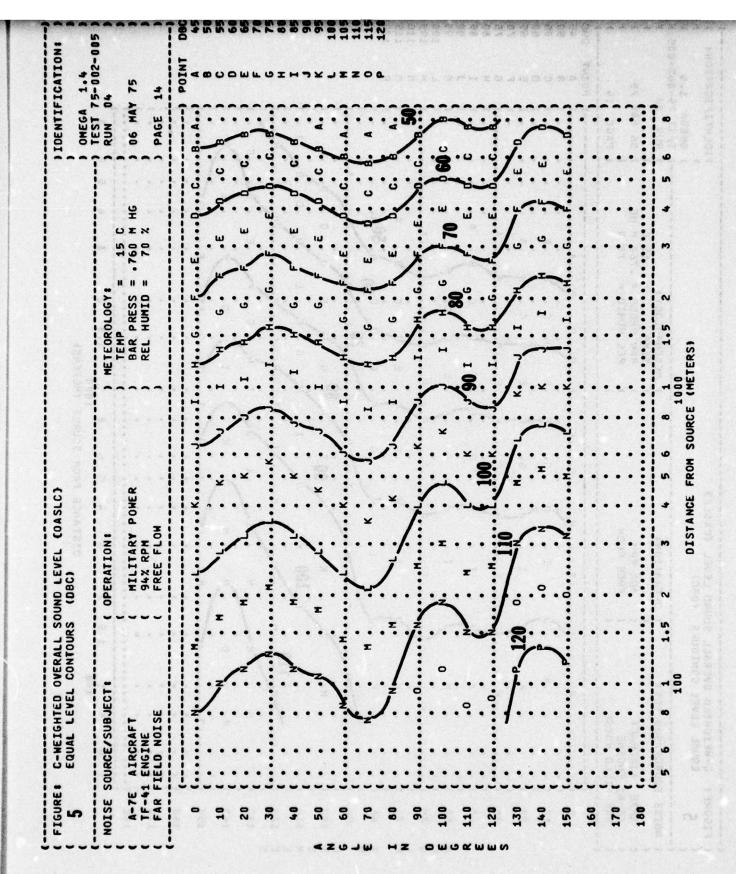
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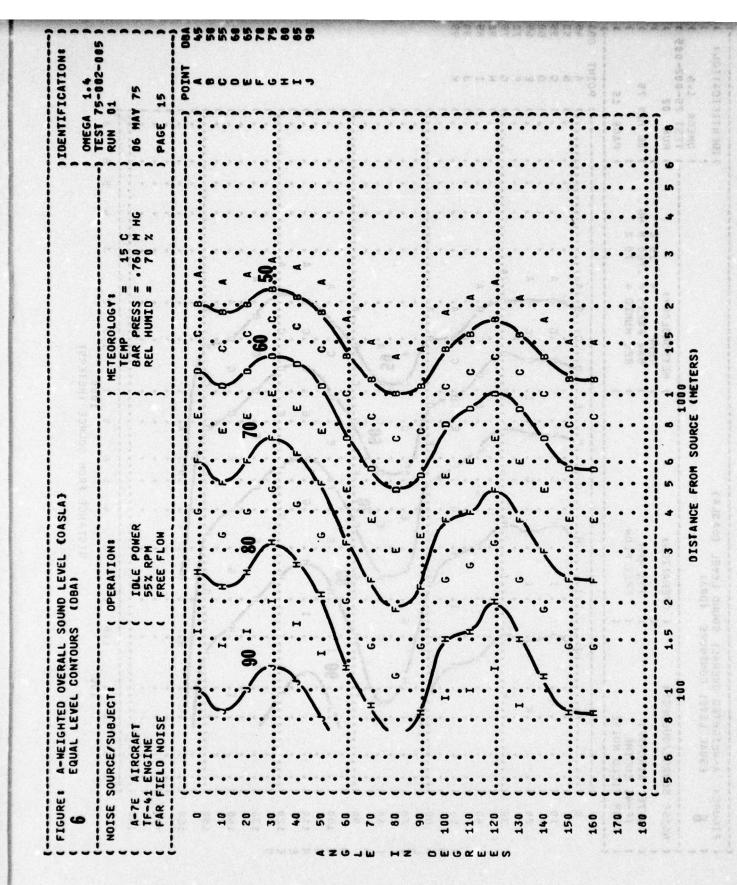


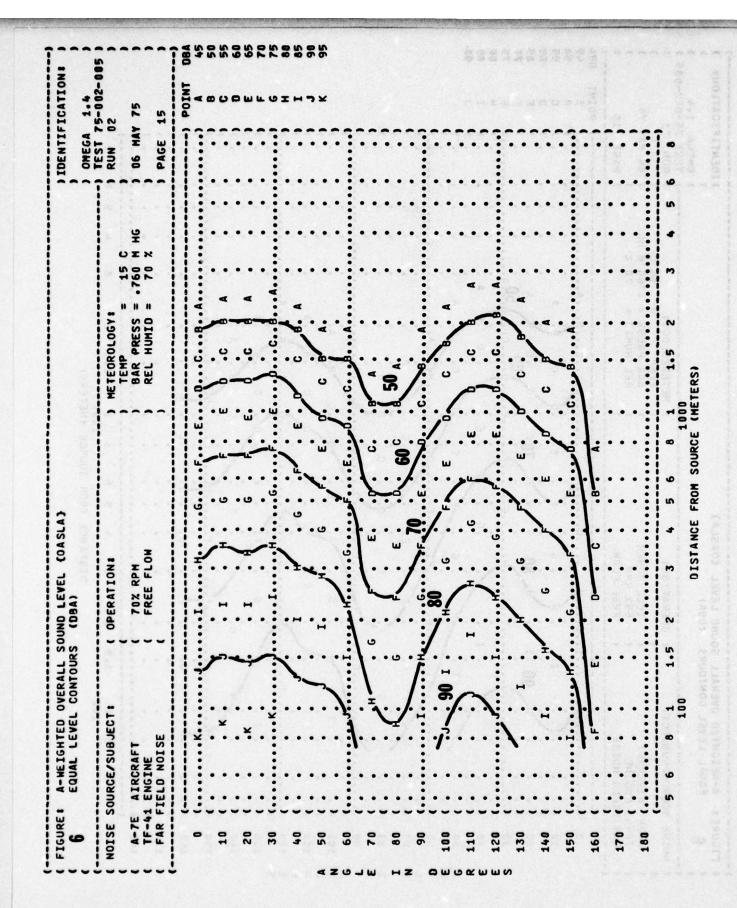


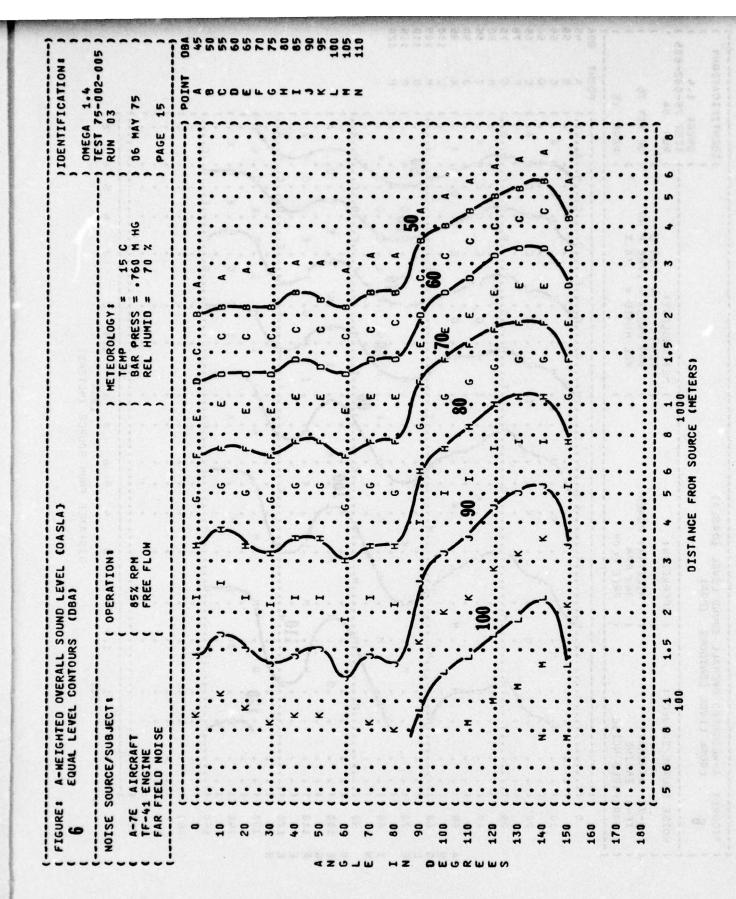


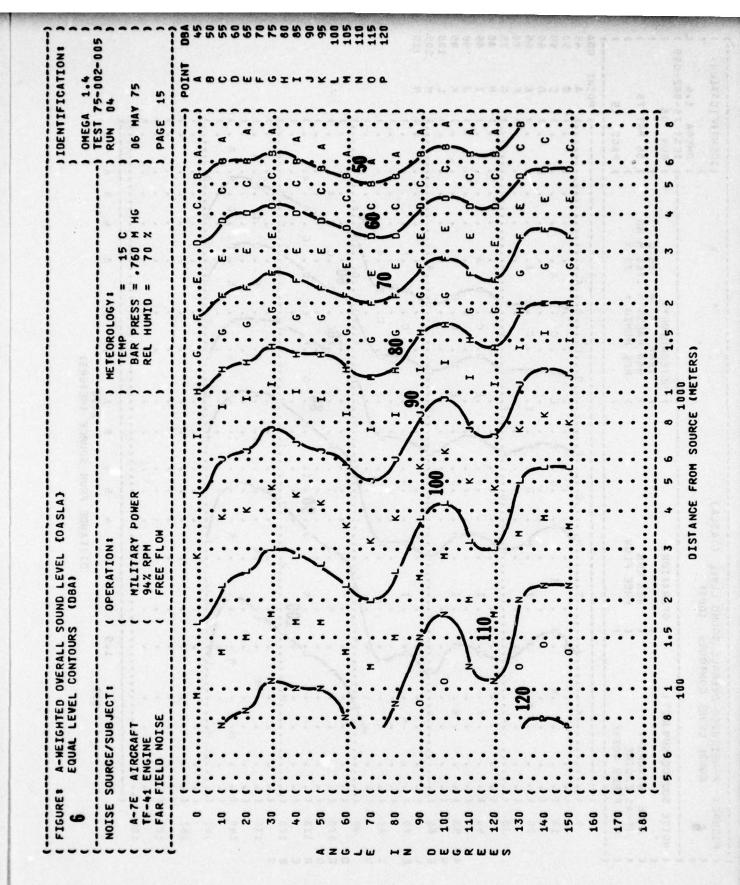






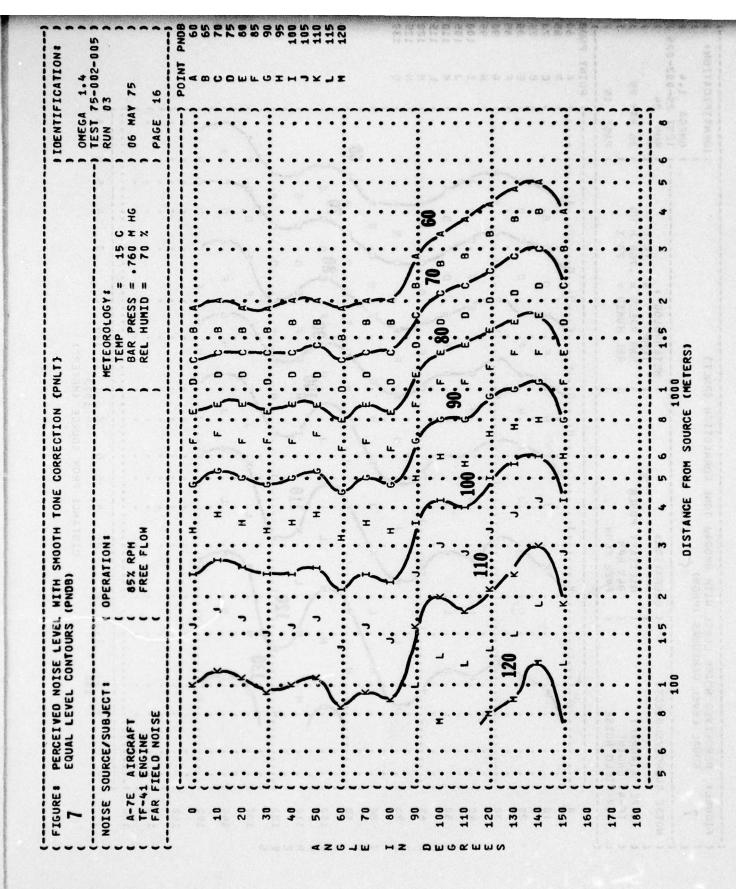


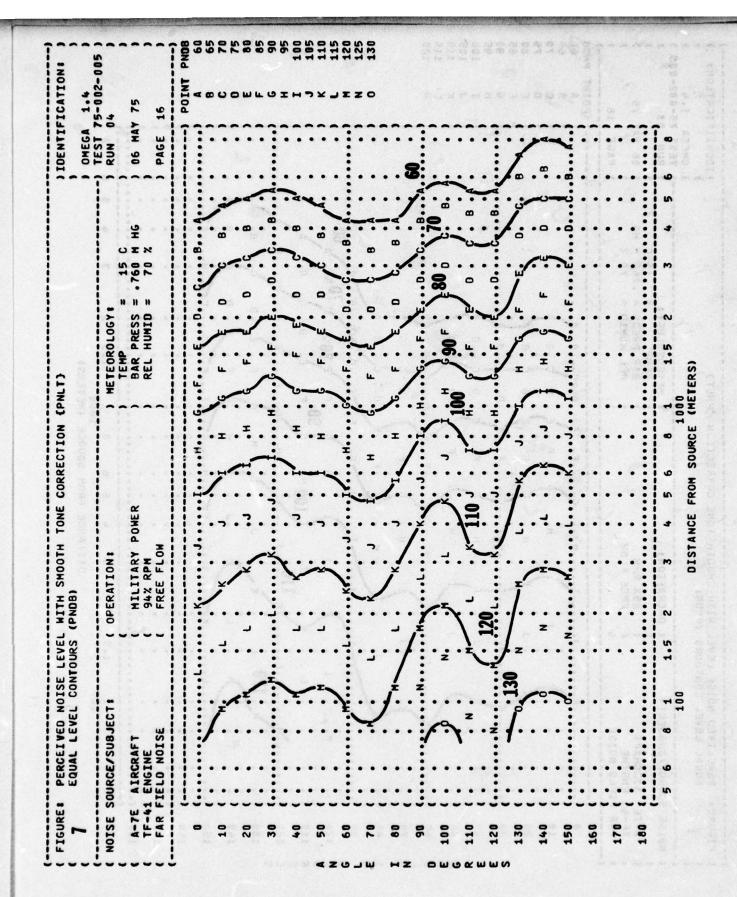




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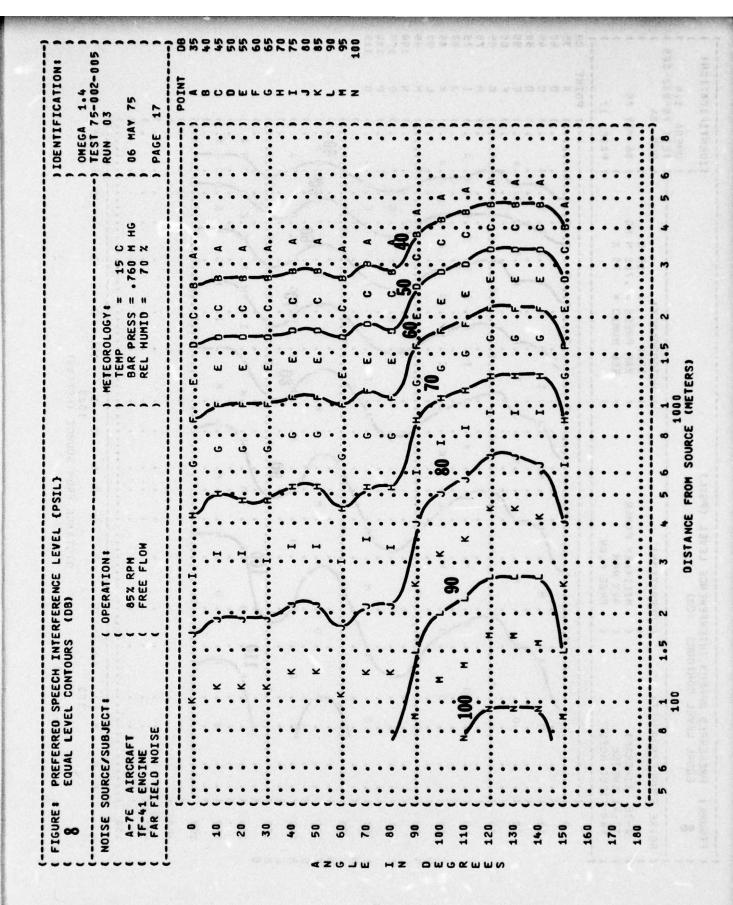
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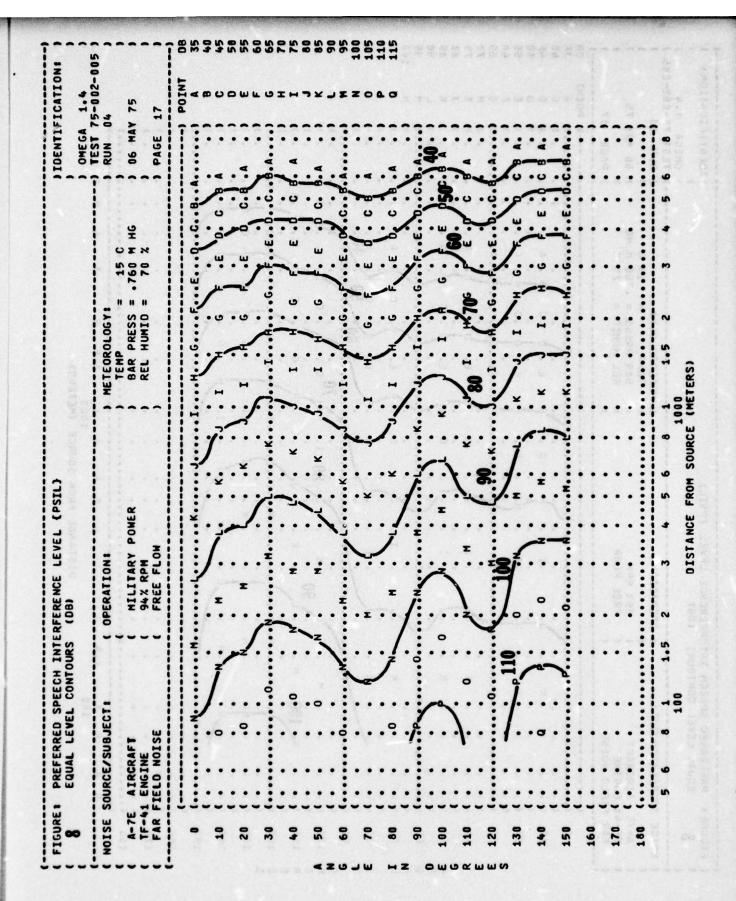




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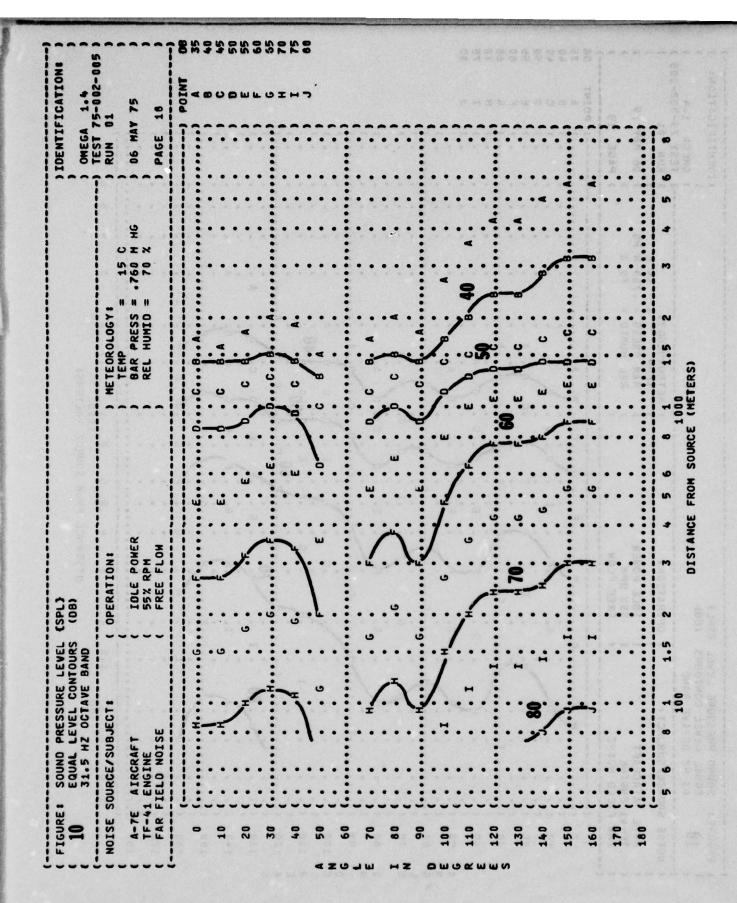
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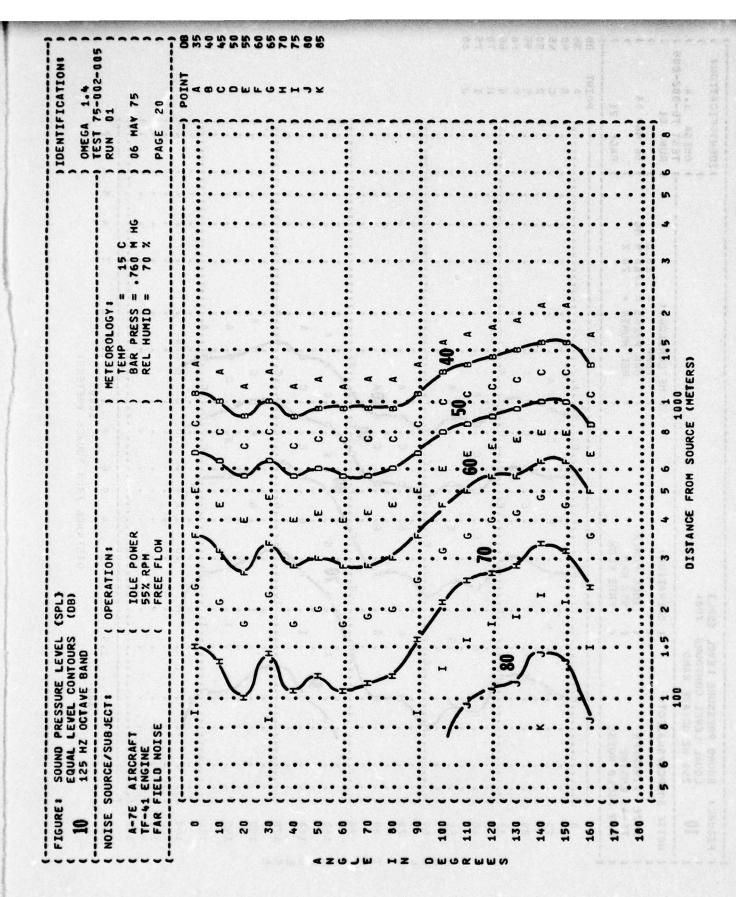
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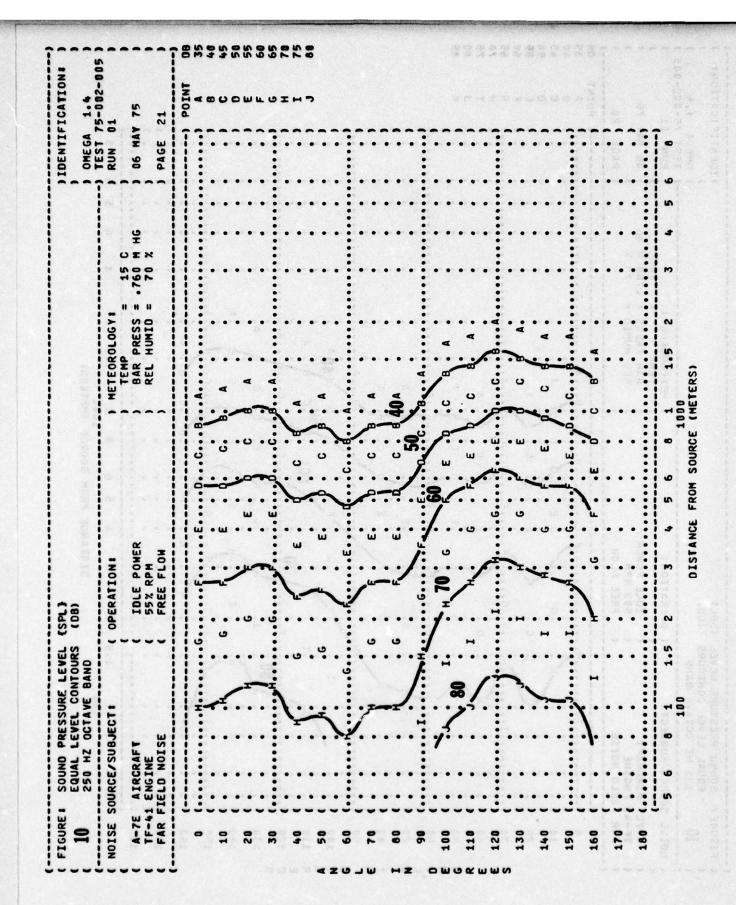
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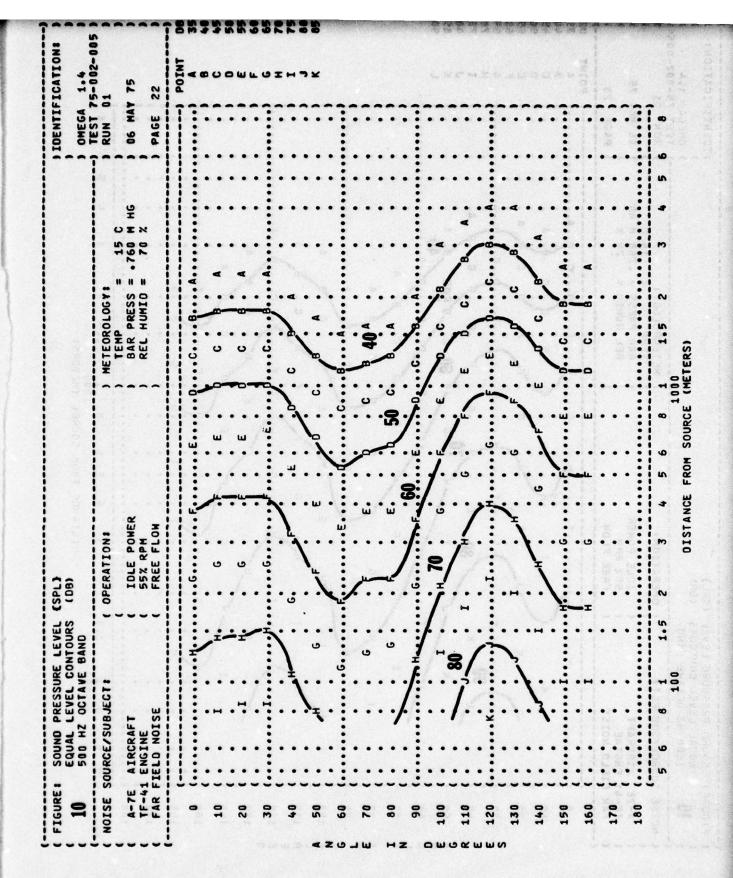


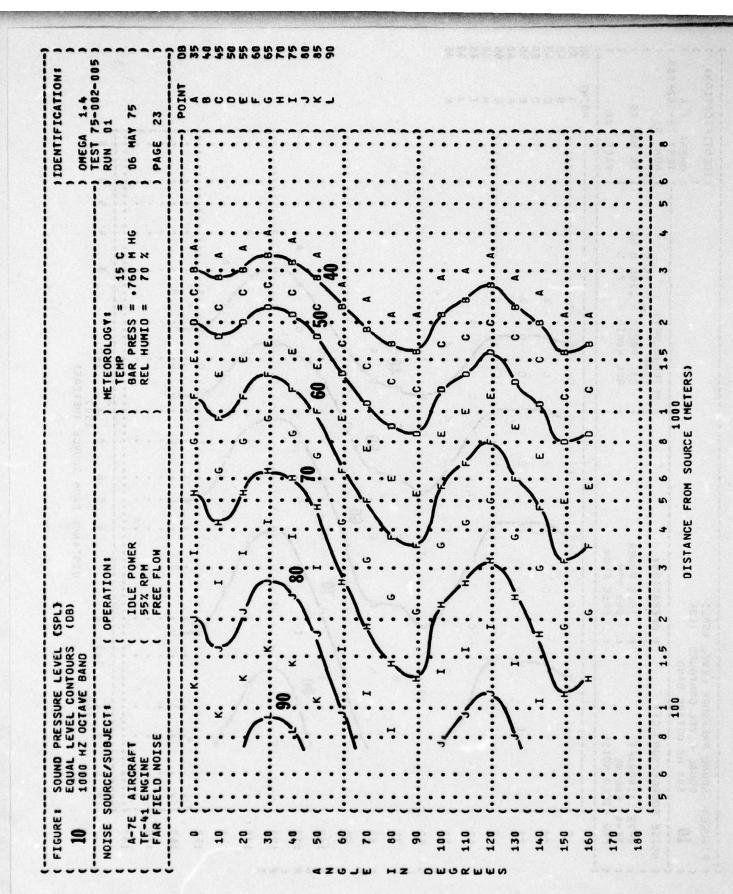
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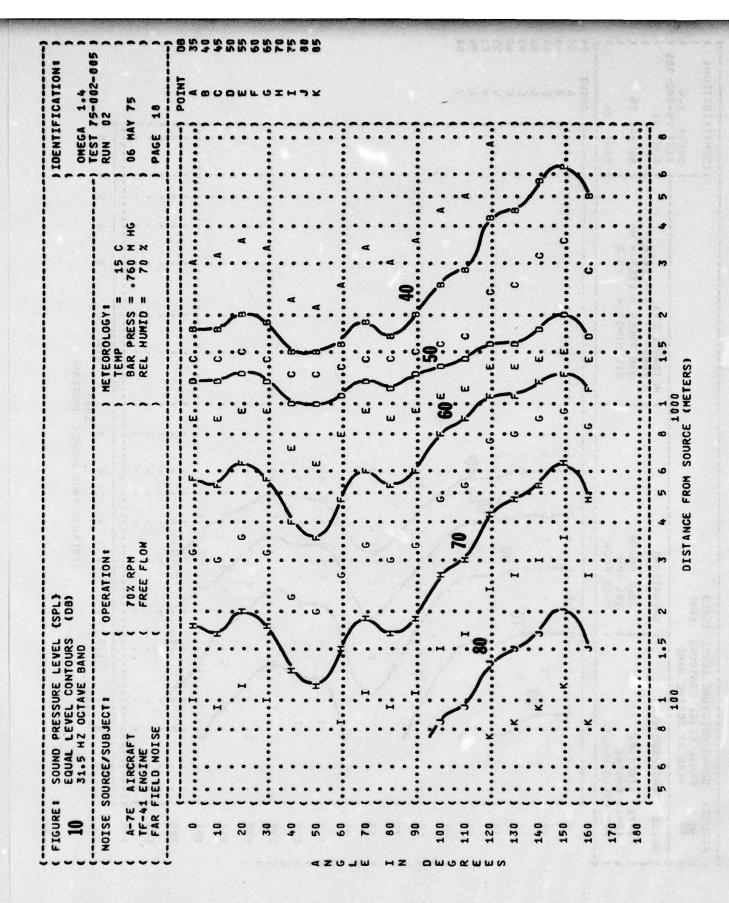


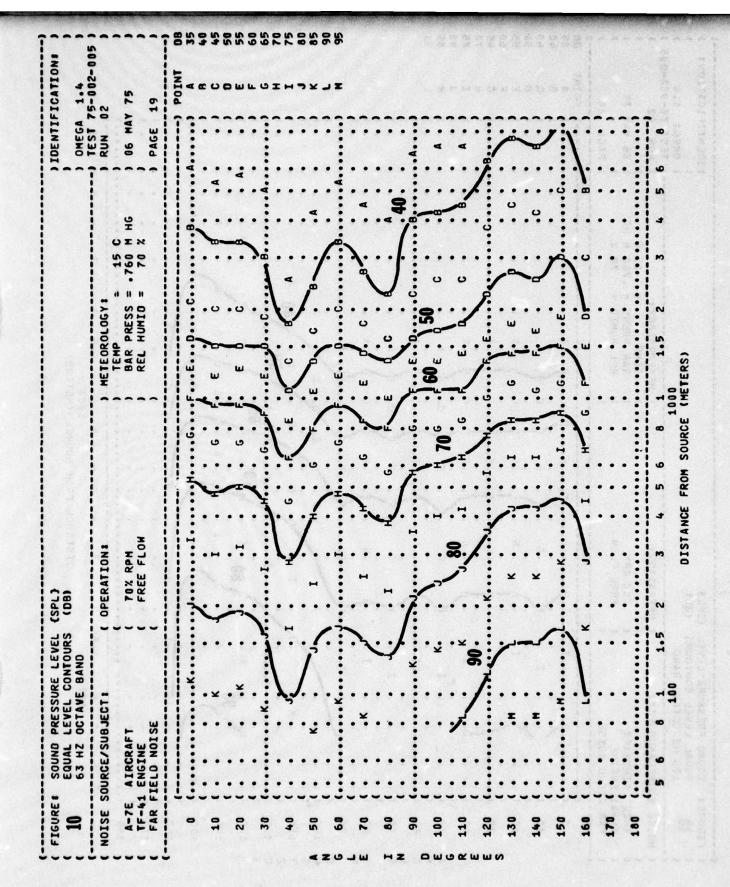


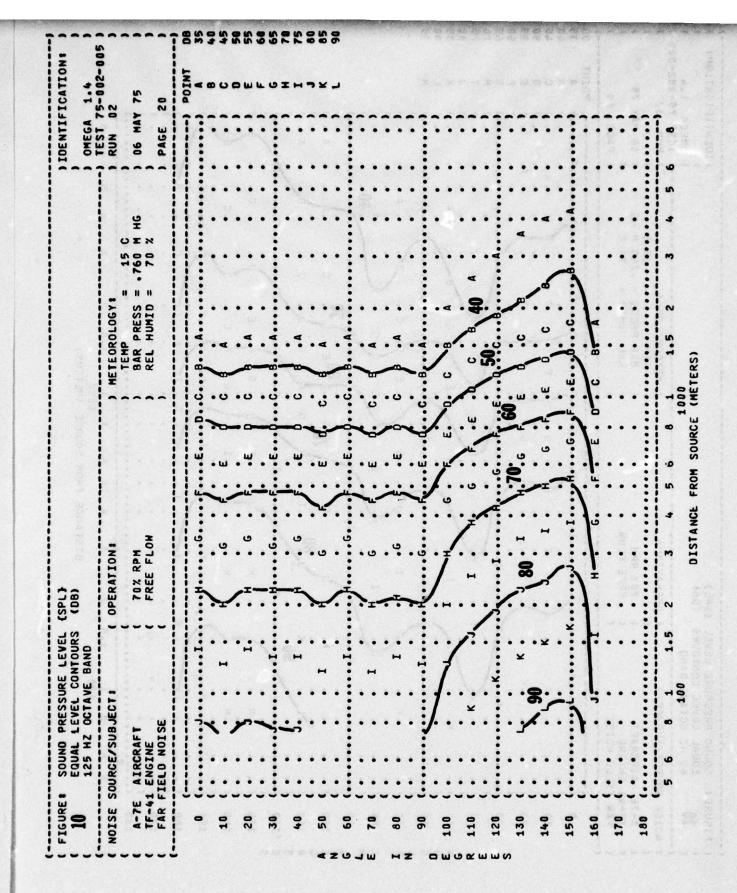
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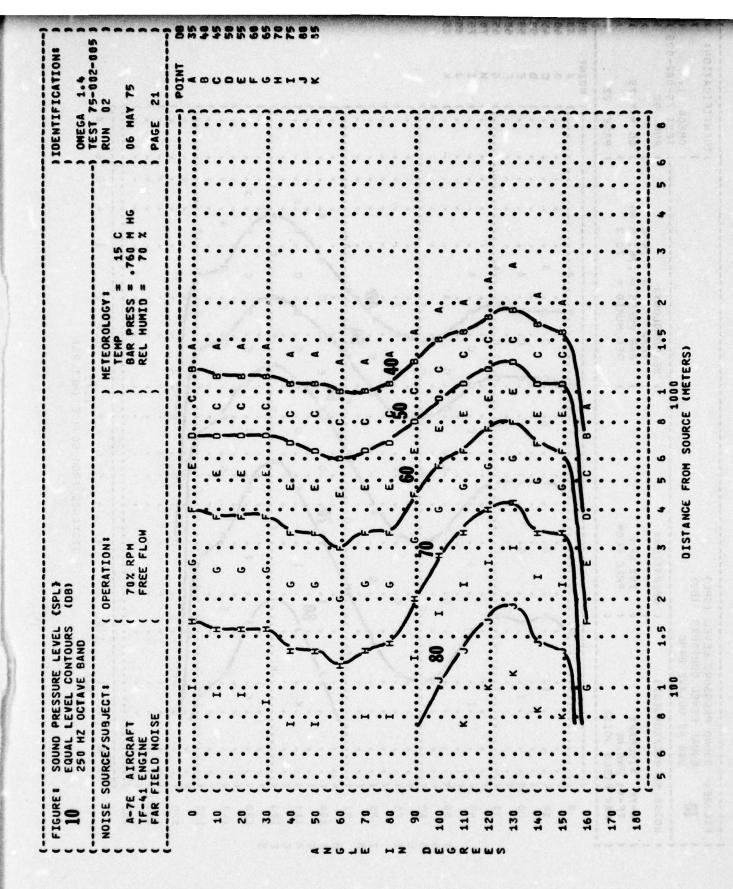
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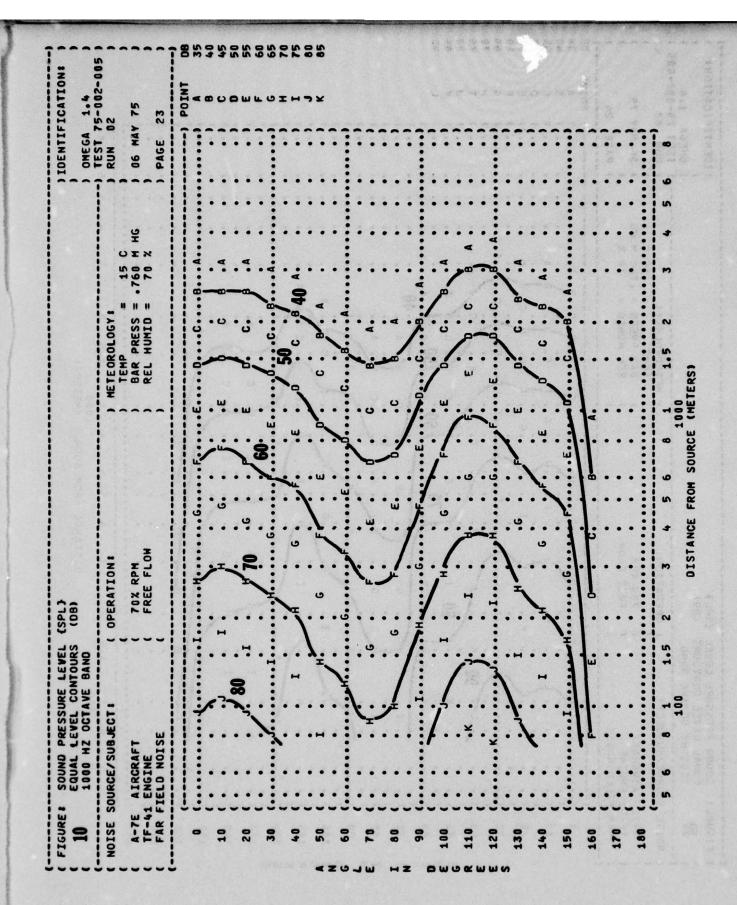


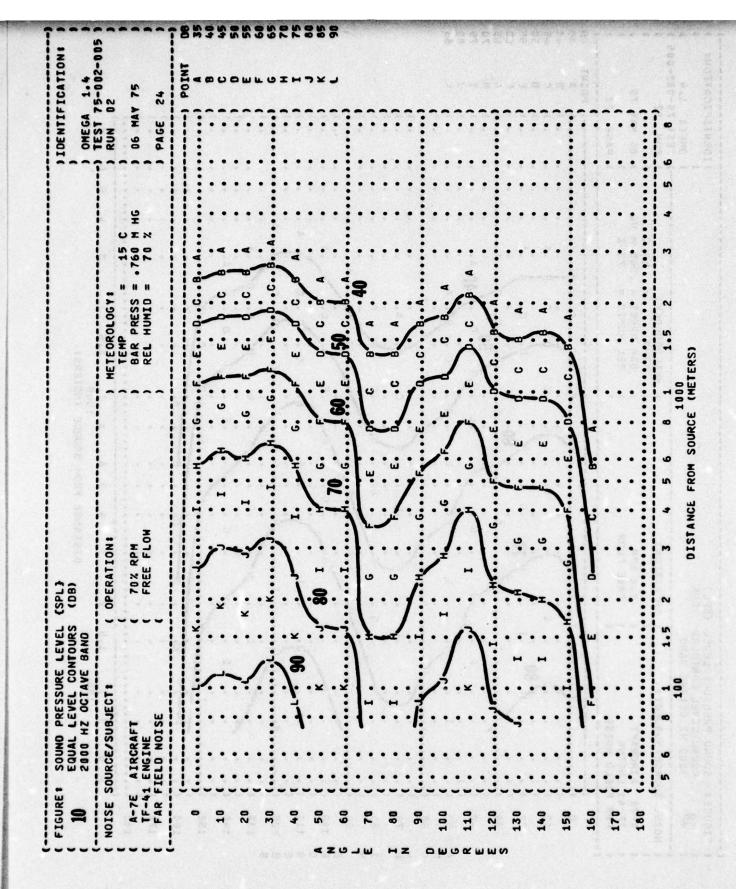




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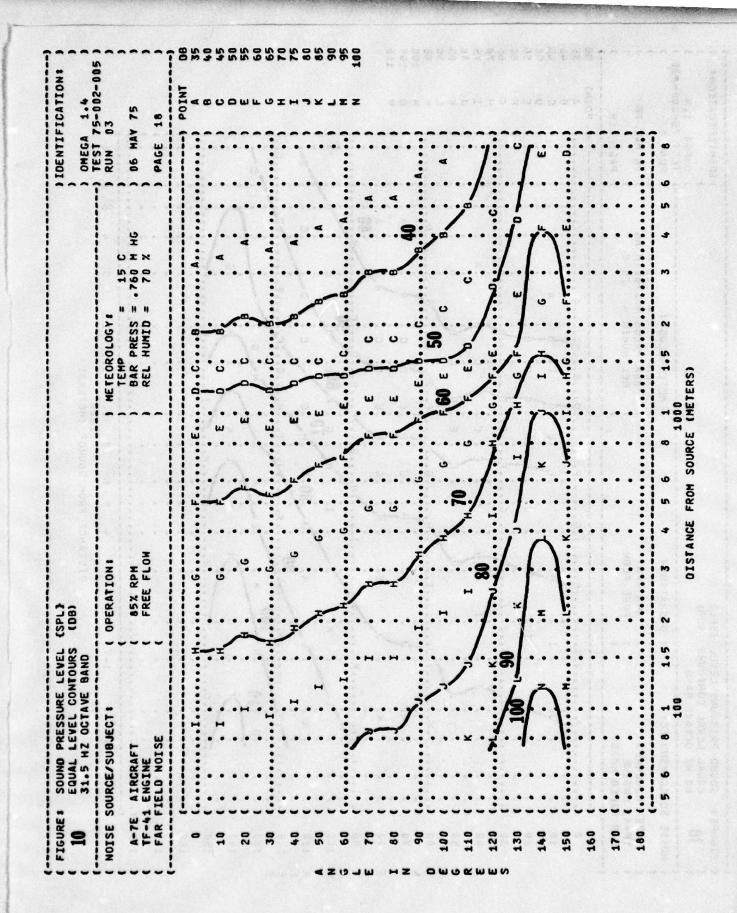


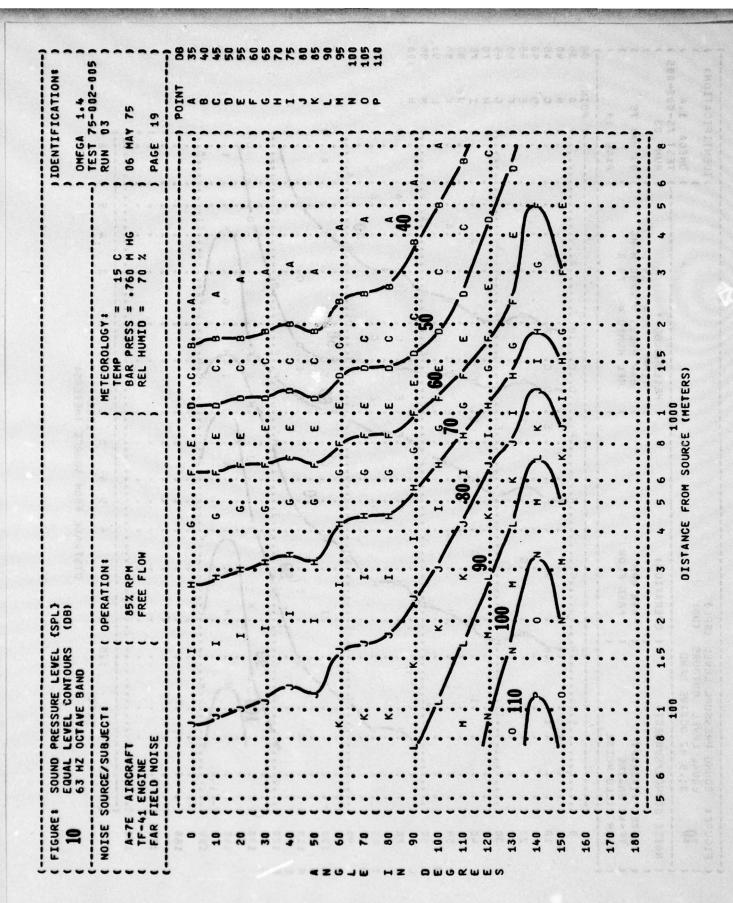


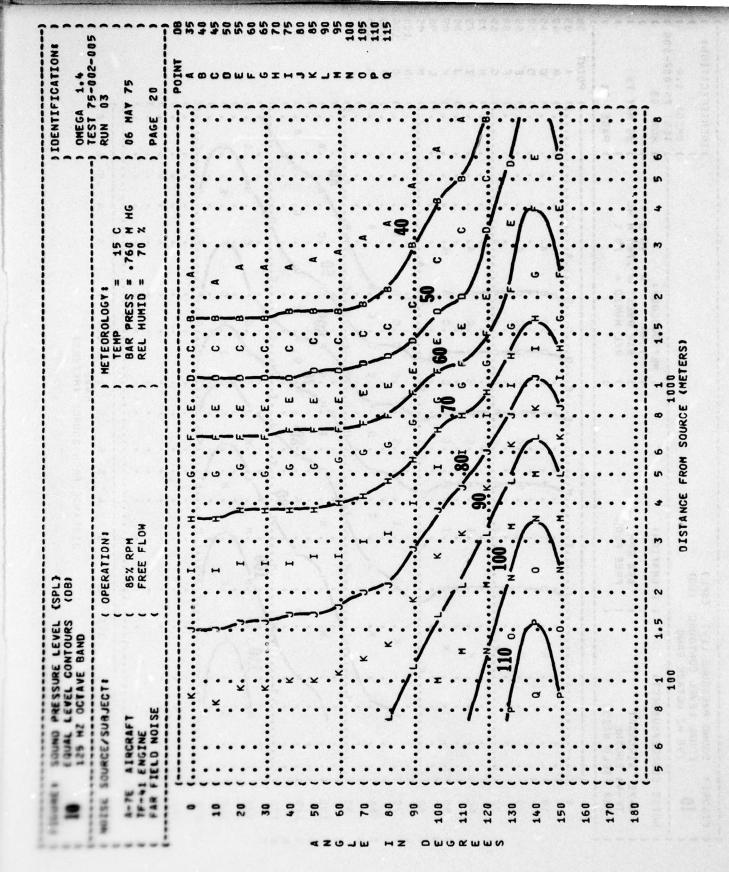


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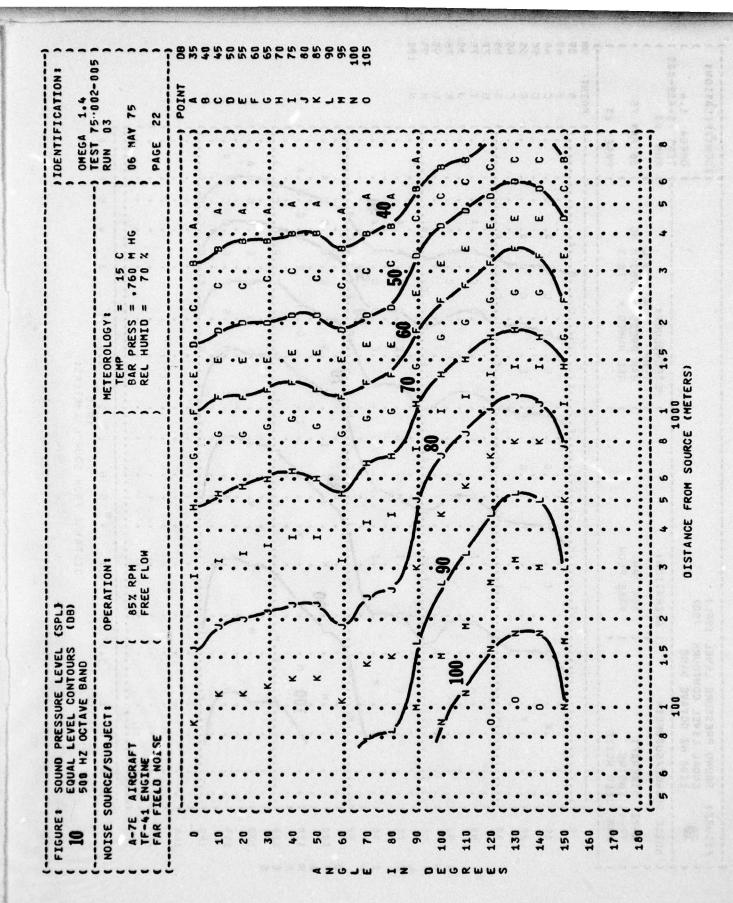
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	SOURCE/SUBJECT: SOURCE/SUBJECT: A I RICRAFT FIELD NOISE		
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FIGURE .	NOISE A-7E TF-4	10 10 20 20 10 0 10 10 10 10 10 10 10 10 10 10 10	90 110 1110 120 130 140 140 1150 1150
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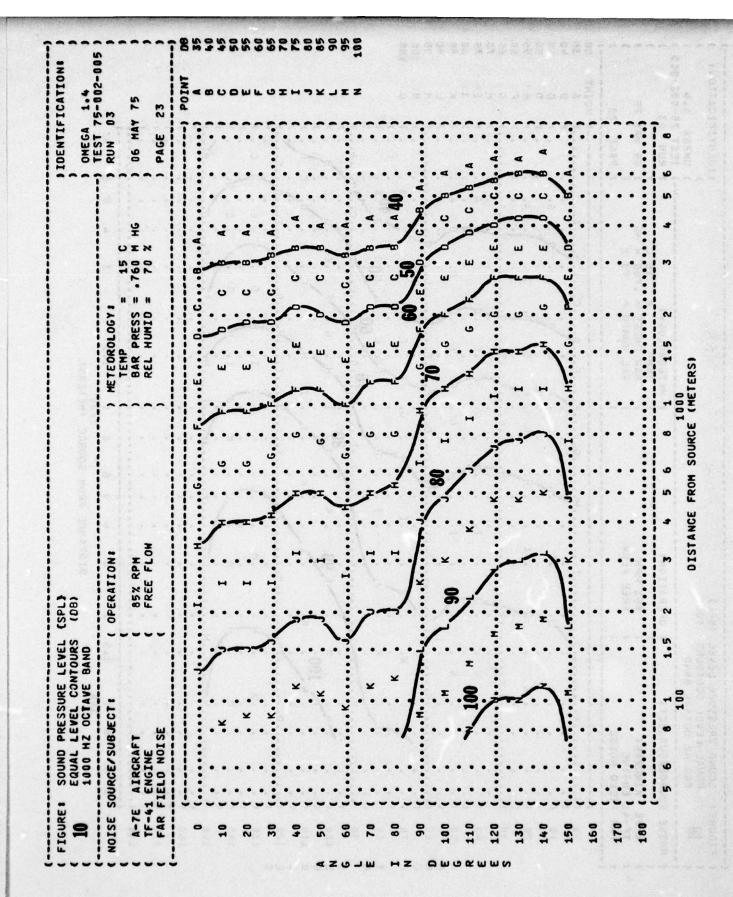


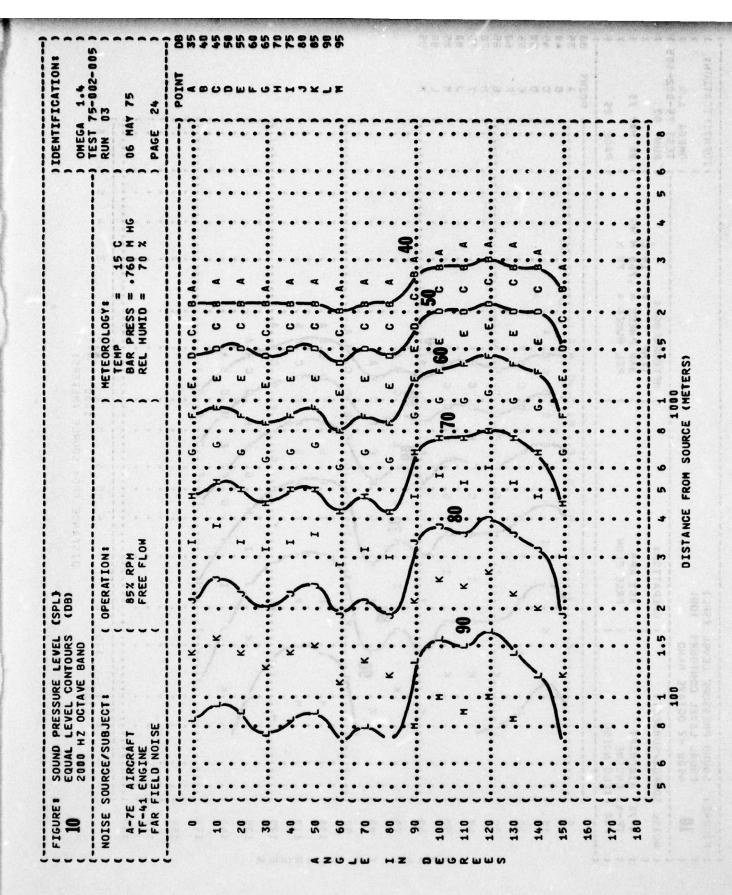


	IH 4	OPERATION:) METEOROLOGY:) RUN 03) OPERATION:) TEMP = 15 C) OF MAY 75) OF RES = .760 M HG) OF MAY 75) OF REE FLOW) REL HUNID = 70 %) PAGE 21)	I H G G F E D G G B A A A A A A A A A A A A A A A A A	
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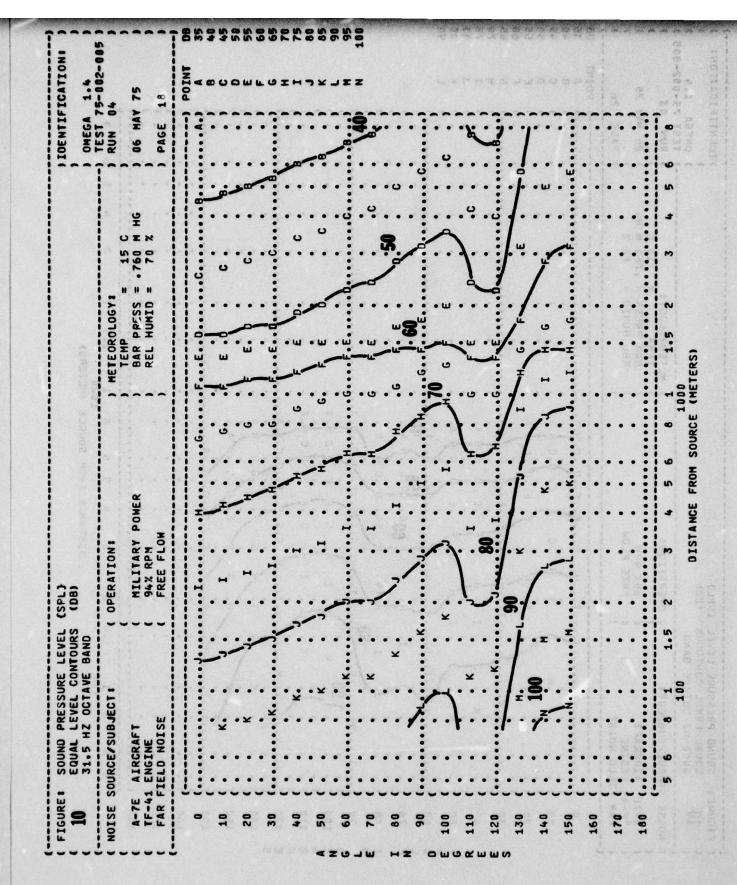


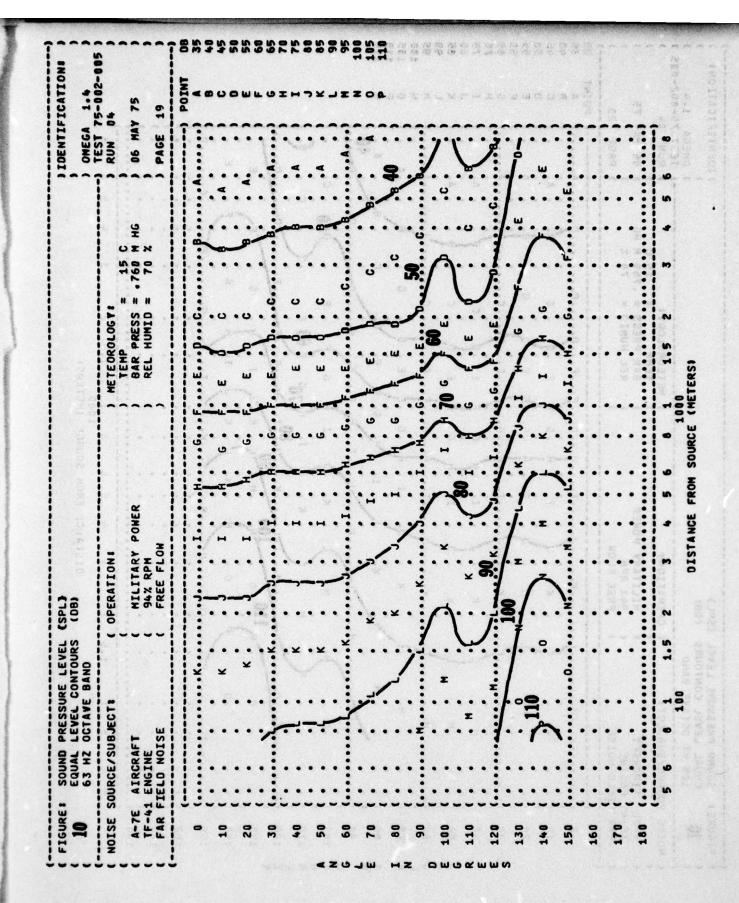


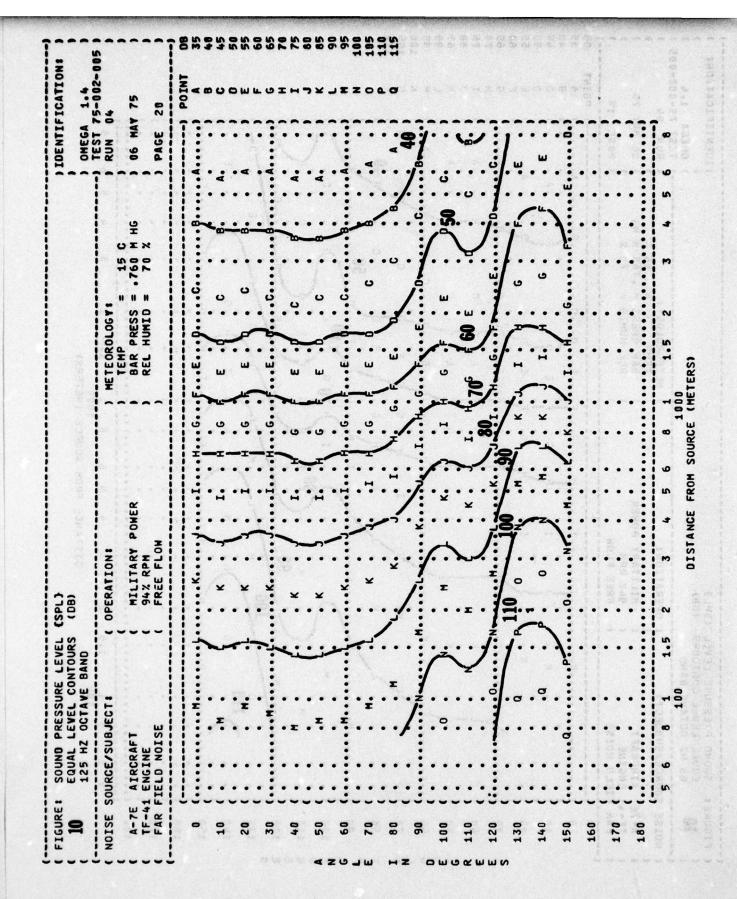
) IDENTIFICATIONS) OMEGA 1.4	2 E E	M4 8000 Mr	O I H T Y J E		3 4 2 0 34 3		
) METEOROLOGY:) TEMP = 15) BAR PRESS = 760) REL HUMID = 70	F E O C B A	E. 0. C. B. A. E. 0. C. B. A. A. A. B. A. A. B. A. B. A. B. A. B. B. A. B.				
EVEL (SPL) OURS (08)	(OPERATION:				· · · · · · · · · · · · · · · · · · ·		
D PRESSURE L LEVEL CON HZ OCTAVE	NOISE SOURCE/SUBJECT: A-7E AIRCRAFT TF-41 ENGINE FAR FIELD NOISE		20 4 K	96 		 160	100

) IDENTIFICATION:) OWEGA 1.4	RUN 03 06 MAY 75 PAGE 26		
	15 C 760 M HG 70 X		In In
	METEOROLOGYS TEMP = 17 BAR PRESS = 17 REL HUNID =		1.5
A ROTATE FARE	••••	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
(DB)	OPERATION: 85% RPH FREE FLOW		
SOUND PRESSURE LEVEL COULDES 6000 HZ OCTAVE BAND			
FIGURE 8 50 10 10 10 10 10 10 10 10 10 10 10 10 10	NOISE SOURCE/SUBJ A-7E AIRCRAFT TF-41 ENGINE FAR FIELD NOISE		

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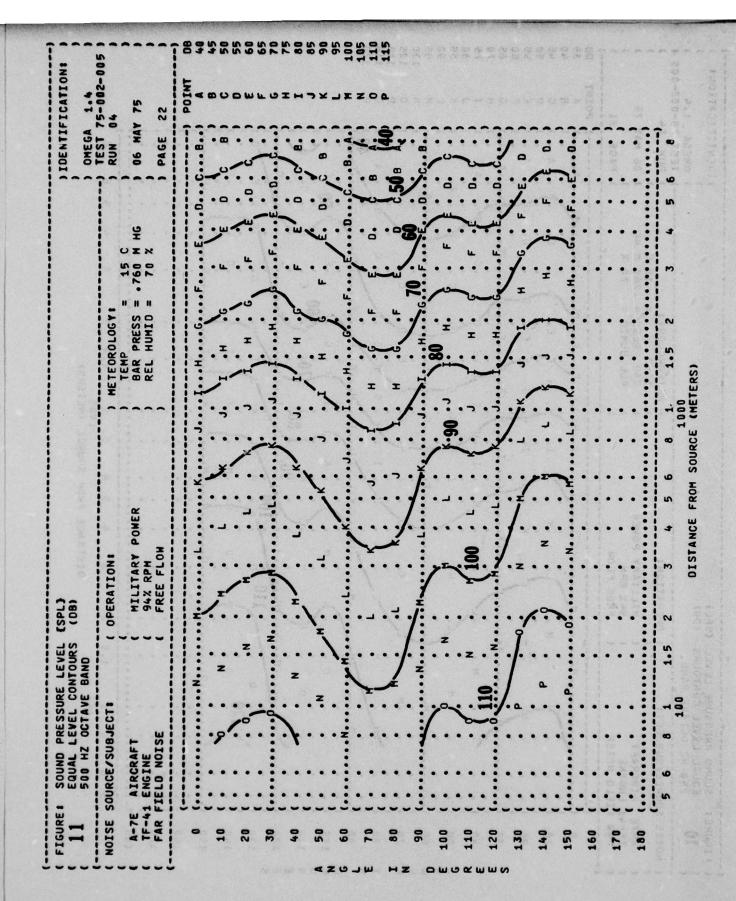


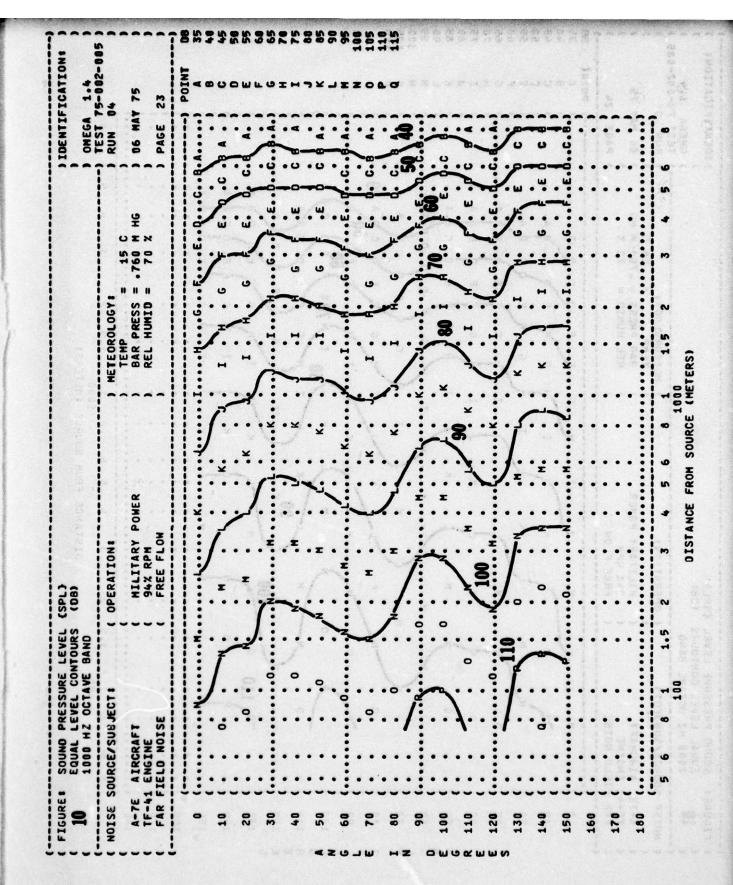


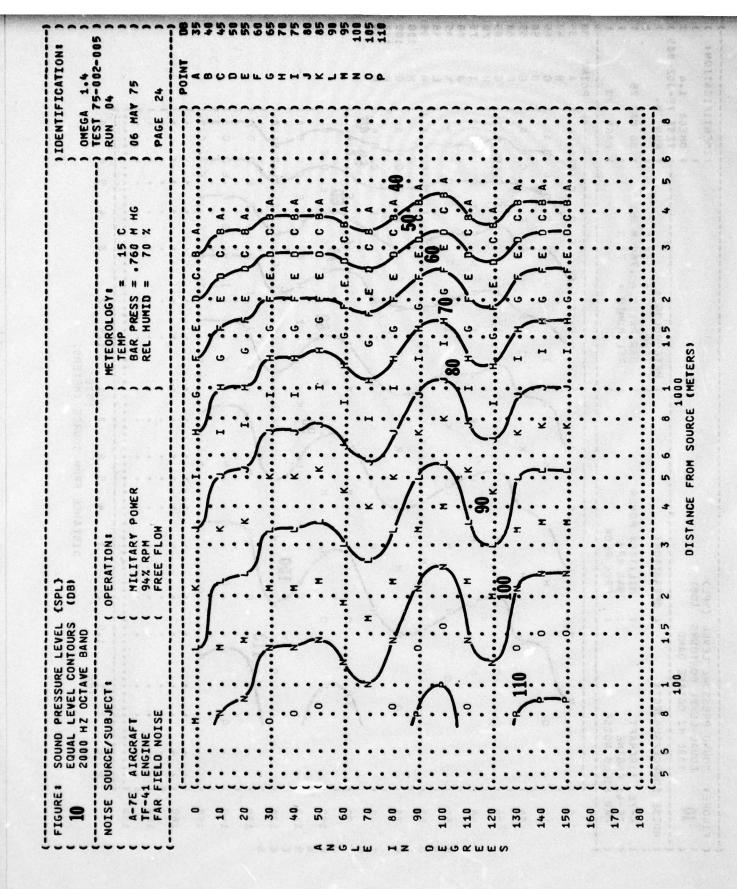


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AEROSPACE MEDICAL RESEARCH LAB WRIGHT-PATTERSON AFB OHIO F/G 20/1
USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK. VOLUME 96. A-7E AIRC--ETC(U)
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AMRL-TR-75-50-VOL-96

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2 OF 2 AD AO48 936







IDENTIFICATIONS OMEGA 1.4	RUN 04 06 MAY 75 PAGE 25		
	5		
	15 C 760 H 70 %		
	METEOROLOGY: TEMP BAR PRESS REL HUMID		1.5
1860	METEORG TEMP BAR P REL H		
		8	
	œ	J	
2 4 4 7 A	POWER		
5	OPERATION: MILITARY 94% RPH FREE FLOW	8 / - \	ю
(SPL)	OPER 941		
LEVEL ITOURS BAND			
SOUND PRESSURE EQUAL LEVEL CO 4000 HZ OCTAVE	SUBJEC IFT	1 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1	
SOUND PI EQUAL LA	ISE SOURCE/SUBJECT: A-7E AIRCRAFT TF-41 ENGINE FAR FIELD NOISE		
FIGURE :	NOISE SOL A-7E I TF-41 E	11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	170 (

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LEVEL CON HZ OCTAVE UBJECT:	1	*	-/	./8	7	1		-
HZ ON HZ ON SUBJEC	OI SE		1	/	···/··	·.j. · · · ·		•
10 EQUAL LEVEL 8000 HZ OCTA NOISE SOURCE/SUBJECT: A-7E AIRCRAFT TF-41 ENGINE	FAR FIELD NOISE							9 5
16 15E SOI 16-7E	E 550		:	:	:	3	:	7